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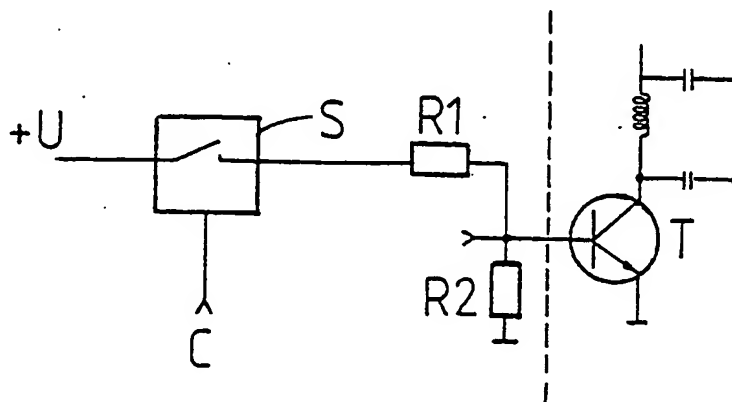
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54 **A method for changing the operating class of a transmitter.**

57 The invention relates to a method for changing the operating class of a radio telephone transmitter used especially in a gsm radio telephone system. When the transmitter comprises one or several power stages of class A, B, AB or C, it is possible

according to the invention to change the operating point of one or several power stage transistors (T) by means of a controlled semiconductor switch (S), whereby the class of the power stage amplifier changes to that desired.



**FIG. 1**

**EP 0 390 360 A2**

A method for changing the operating class of a transmitter

The invention relates to a method for changing the operating class of a transmitter when the transmitter comprises one or several power stages of class A, AB, B or C.

With the aid of the power stage of a radio telephone transmitter, the regulation of low power levels should be easy to carry out and at high powers the efficiency of the power stage should be maximal. The power spectrum produced when the transmitter is started up should widen as little as possible. In practice a power stage is a compromise with respect to these contradictory requirements. Usually in practice the power stage is a class C power amplifier. A class C amplifier has high efficiency, but the regulation of the power levels is difficult to carry out. In a class AB amplifier the regulation of power is easy to carry out, since a class AB amplifier functions more linearly than a class C amplifier. A class AB amplifier has the disadvantage of low efficiency. Especially in hand telephones, high efficiency is an important property to be aimed at, since it lengthens the operating time of a battery-operated telephone and reduces the heating up of the power stage.

The object of the present invention is to provide a method for use in the transmitter of a radio telephone, especially a radio telephone used in a digital GSM system, the transmitter being capable of eliminating disadvantages of prior art power stages and enabling the operating class of the amplifiers of the transmitter power stages to be selected so as to obtain the best possible result with respect to transmitter efficiency, the regulation of low power levels, and the widening of the power spectrum produced at the start-up. The method is characterized in that the operating point of the power transistor of one or more transmitter power stages is changed by separate control of the base voltage.

By changing the operating point, an amplifier of class A, B, AB or C can be converted into another amplifier of the said group. If the power stage has several power stages coupled in succession, the operating point of each amplifier is controlled independently, whereby the desired combination of amplifiers of the desired class is obtained. The control is effected by supplying a predetermined bias voltage to the base of the power transistor. The switching transistor is controlled by means of the microprocessor of the radio telephone.

The method according to the invention is described in greater detail with reference to the accompanying figures, in which

Figure 1 depicts a simplified circuitry of one power stage, with the control according to the invention, and

Figure 2 depicts the principle of the control in a multiple-stage power stage circuitry.

Figure 1 shows in a simplified manner a power stage, which is here represented by one power transistor T with its peripheral components. The power stage is on the right-hand side of the vertical dashed line in the figure. In accordance with the invention, the operating point of the power transistor T is changed by means of a switch S, which a microprocessor (not shown) controls from the control line c. When the switch is open, the power stage operates in class C and the operating point is determined by the base resistance R2. When the switch S is closed, the voltage divider R1-R2 is connected to the supply voltage U of the device, whereupon the transistor base voltage increases and the operating point of the transistor T changes. The amplifier now becomes, for example, a class AB amplifier.

If, in accordance with Figure 2, the power stage of the transmitter comprises several successively coupled power amplifiers 1, 2, 3 and 4, separate control is provided for each of them. By means of each individual control it is possible to switch each amplifier as an amplifier of the desired class. By suitably varying the class at different power levels it is possible suitably to optimize the result with respect to the transmitter efficiency, the regulation of low power levels, and the widening of the power spectrum produced at the start-up. The control of the amplifiers coupled in succession is implemented using the microprocessor of the radio telephone.

In a preferred embodiment of the invention, an amplifier can be switched between two classes. At low power levels the amplifier is switched as a class AB amplifier, and at high power levels it is switched as a class C amplifier. The adaptations between the amplifier stages are implemented so as to be dependent as little as possible on the change of the base impedance of the power transistor when the operating point changes.

By the method according to the invention, an optimal switching of the amplifier or the amplifier stages is obtained in accordance with the power level, whereupon the best possible efficiency can be optimized for the transmitter.

## Claims

1. A method for changing the operating class of a transmitter when the transmitter comprises one or several power stages of class A, B, AB or C, characterized in that the operating point of the power transistor (T) of one or several power stages is changed by means of a controlled switch (S), whereby the class of the amplifier of the said

power stage changes to that desired.

2. A method according to Claim 1, **characterized** in that at high power levels the amplifier is controlled to operate in class C and at low power levels the amplifier is controlled to operate in class AB. 5

3. A method according to Claim 1, **characterized** in that the adaptations between the amplifier stages (1, 2, 3, 4) are implemented so as to be dependent as little as possible on the change of the base impedance of each power stage when the operating class of the power amplifier changes. 10

4. A method according to Claim 1, **characterized** in that the controlled switch (S) is a transistor switch, the opening and closing of which is controlled by the radio telephone microprocessor from the control line (c), in which case, when the state of the switch changes, the base voltage of the power stage transistor (T) changes and at the same time the operating class of the amplifier changes from class AB to class C, or vice versa. 15 20

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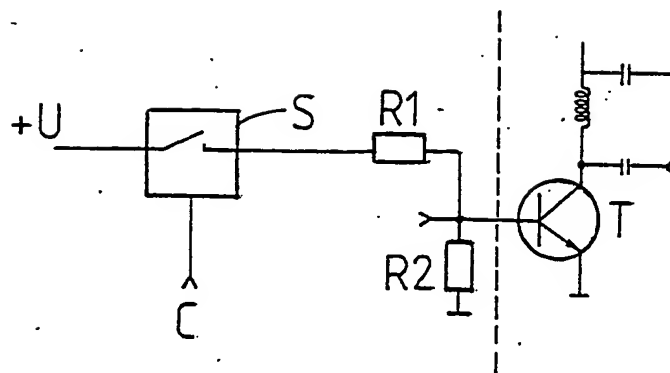


FIG. 1

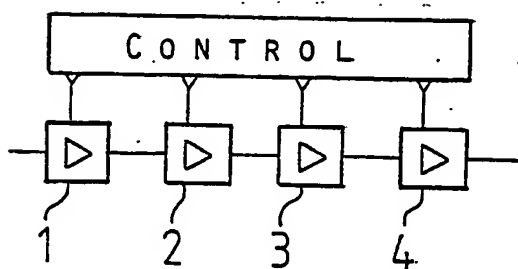


FIG. 2